PTE contamination assessment in marine sediments and soils in Van Phong Bay

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Abstract

In recent years, industrial activities developed in Van Phong bay (South-Central Vietnam) have raised an urgent environmental concern related to the use of copper slag as abrasive material for repairing ships. This study was conducted to investigate the Potentially Toxic Element (PTE) contamination of sediments and soils due to the impact of dumping blasted copper slag (BCS). Enrichment Factors (EF) were calculated, using the local background concentrations of PTEs derived from sediment/soil core analysis. Moreover, mobility of PTEs from the BCS and selected sediments were performed by single extractions ($CaCl_2$, NaCl, EDTA, and CH_3COOH). PTEs in both sediments and BCS show a low actual mobility and were not easily mobilized by sea water, and organic complexation. Zinc, Cu, Pb and As in the contaminated sediments and BCS represent a “high risk” for the environment, as indicated by the high Risk Assessment Code (RAC).

Background-Objectives

Using copper slag in shipping industry in Van Phong Bay has raised an environmental concern related to the release of PTEs

Objectives

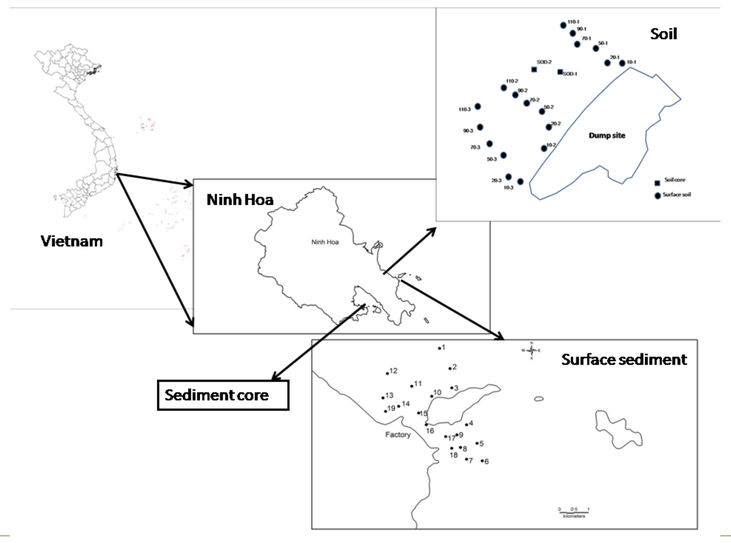
- Assess the PTE contamination status of sediments and soils
- Investigate the leachability of PTEs from BCS and sediments

Methodology

- **Sampling**

***Sediments*:** 19 marine surface sediment samples and 1 core sample (150 cm)

Soils: Surface soil samples collected at 10m, 20m, 50m, 70m, 90m and 110m from the dump site and 1 core sample (160 cm)



- **Contamination assessment**

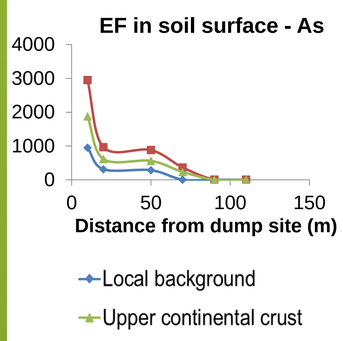
Using Enrichment Factors (EF)
Background concentrations derived from core samples

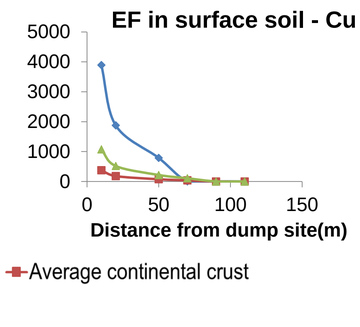
- **Leachability of PTEs**

Single extractions with $CaCl_2$, NaCl, EDTA, and CH_3COOH

Results-Discussion

PTE contamination assessment

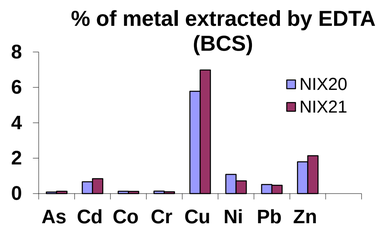




With local background concentrations: EF of Cu >> EF of As

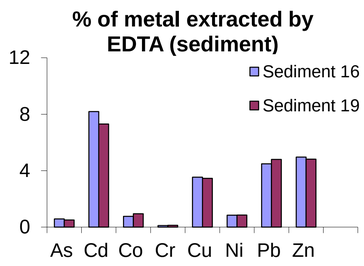
Mobility of PTEs

Low mobility with $CaCl_2$ and NaCl extraction < 1 % total concentration



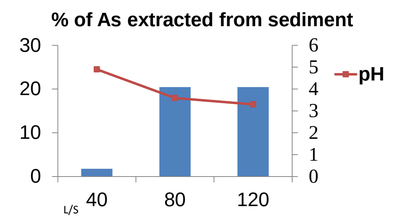
BCS: Cu > Zn > Ni > Cd > Pb

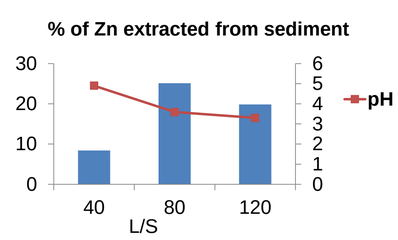
Sediments: Cd > Zn > Pb > Cu > Ni



PTEs in the sediments and BCS: not mobilized easily with an organic complexation agent (< 10 %)

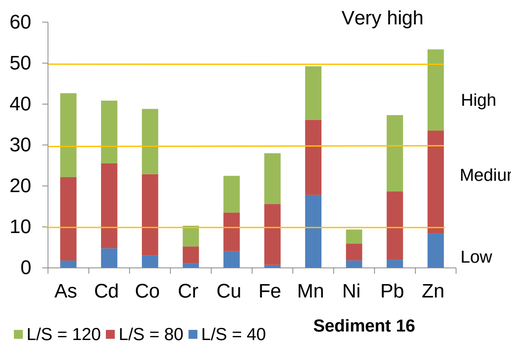
CH_3COOH extraction





- Zn > As ≈ Cd ≈ Co > Pb > Cu > Cr > Ni

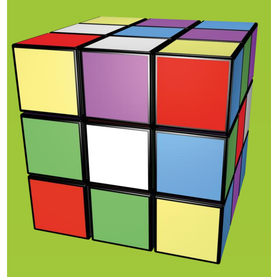
Risk assessment code (RAC) based on CH_3COOH extraction



Zn, Pb, Cd, Co and As: the cumulative risk reaches a “high” to “very high” level

Conclusions

- Sediments/soils: strongly contaminated with As, Cu and Zn
- Using local background values of PTEs in soils and sediments => correct estimation of the degree of PTE contamination
- Acidification: more significant effect on PTE release in sediments (except Cd and Pb) and BCS
- RAC and total concentration: High risk of Zn, Cu, Pb and As



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